Diamond Booster RF

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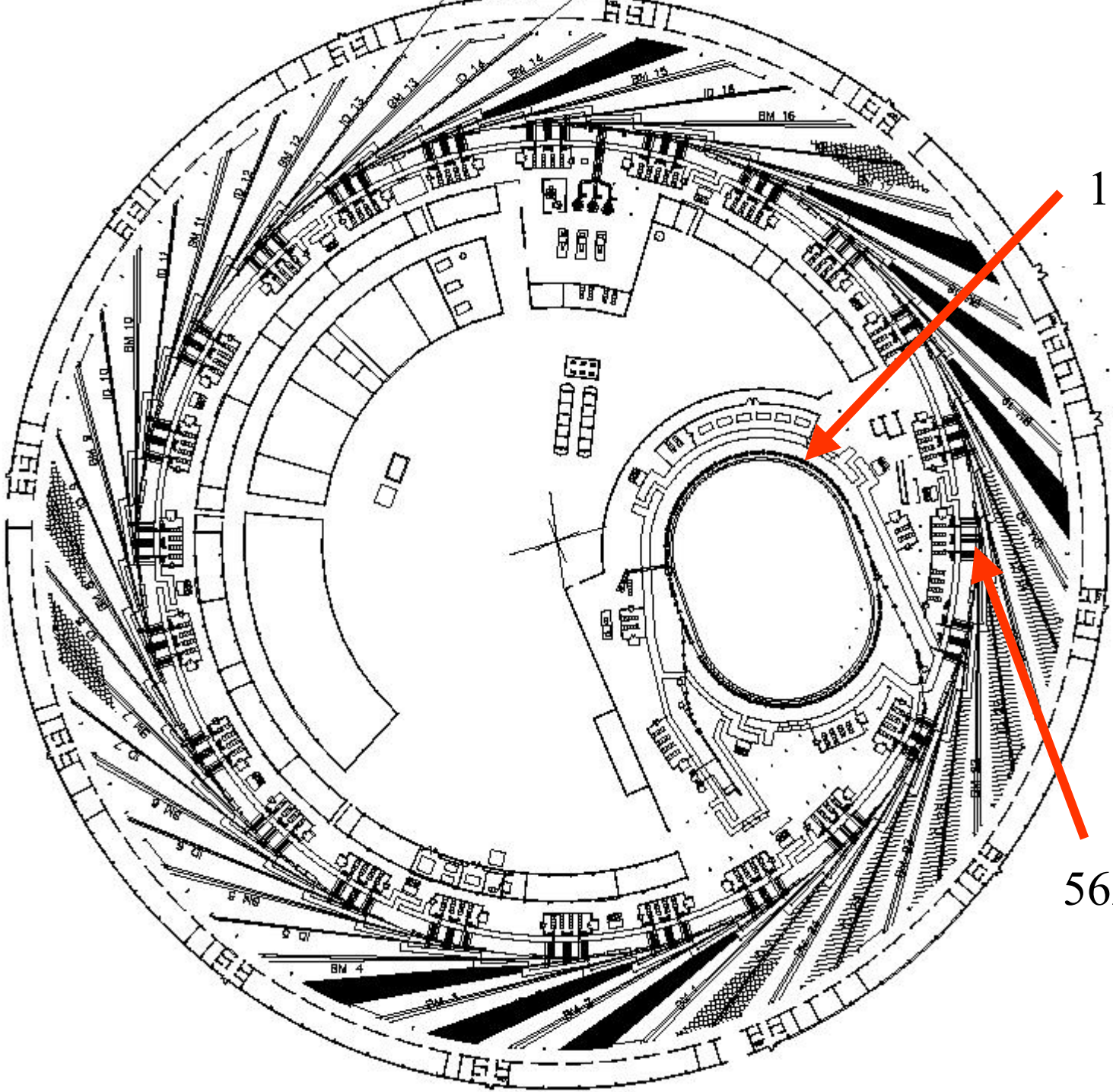
Contents

- Introduction
- Diamond Booster
- Booster facts and figures
- RF Cavity
- RF power system
- Timescale

Introduction

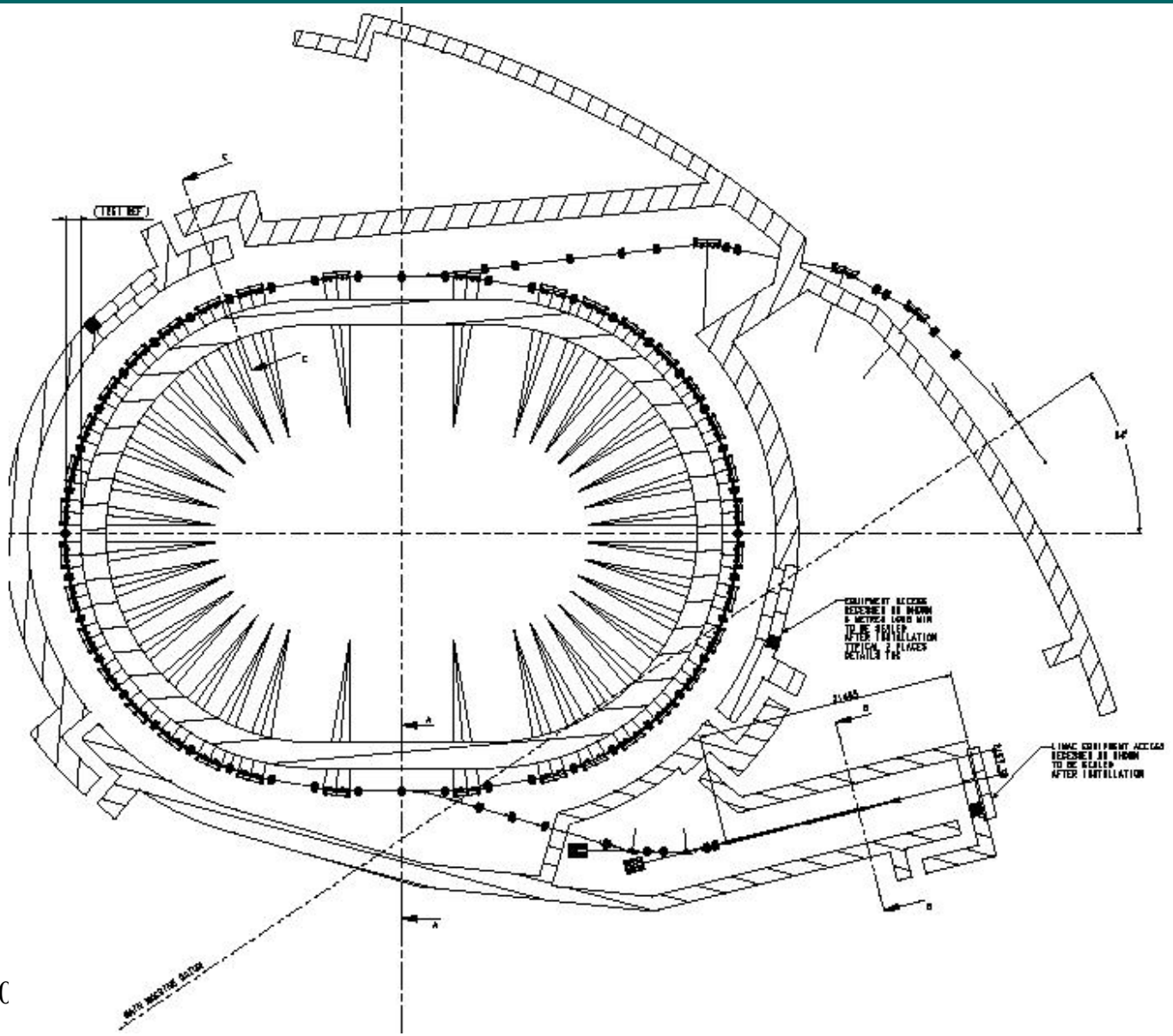
- 3Gev Booster
- Linac at ~100Mev
- Extraction at 3GeV
- Top up operation
- Racetrack design based on the SOLEIL Booster
- Maximum emittance of 150 nm rad
- Good injection/extraction system
- 1 RF cavity
- Design still very fluid



No

Booster lattice

- 2-fold symmetric missing dipole FODO lattice
- 22 cells with 36 dipoles, 8 missing dipole sections
- 44 quadrupoles
- 44 sextupoles
- 22 dual plane BPMs
- 22 H correctors, 22 V correctors



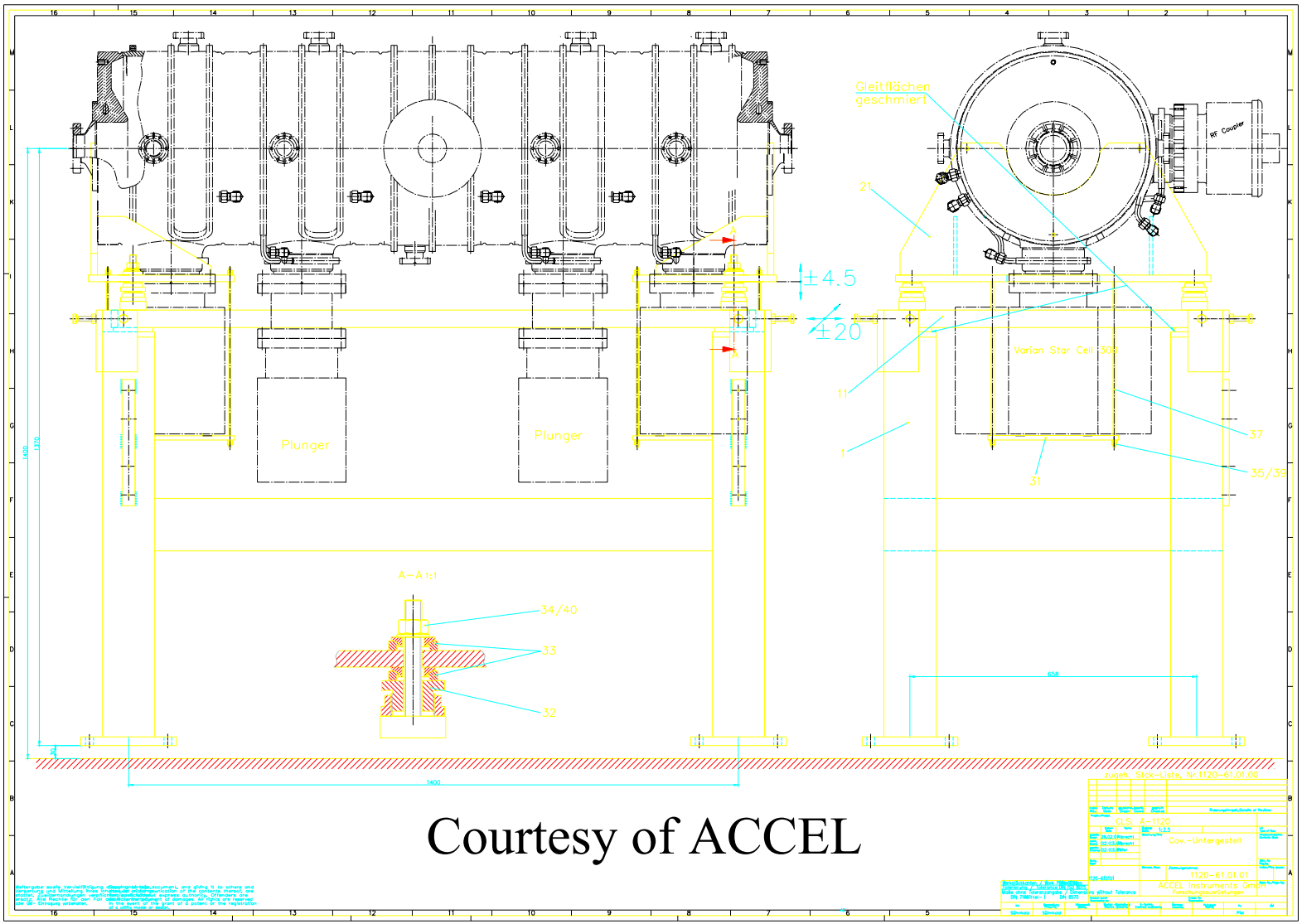
Facts and figures

- Beam energy 3GeV
- Beam current 3.17mA
- Loss/turn 0.57MeV
- Harmonic No. 286
- 158.4 metres Circ
- Cells 22
- Super periods 2
- Fs 35kHz
- Quantum lifetime ~45
- Momentum compaction 0.0285
- Cav coupling 1.11
- Cav volts 1.1MV
- 499.654 MHz
- RF power 54kW
- Cav power 48kW
- Beam power 5.7kW
- Rep rate 5Hz

Cavity

- Commercial Petra 5 cell cavity
- Multi-cell cavity, very high R/Q
- Manufactured by ACCEL
- Used at CLS and soon at ELLETRA
- Proven record, over 200 cavities in operation at DESY
- Control electronics can be supplied

Courtesy of ACCEL

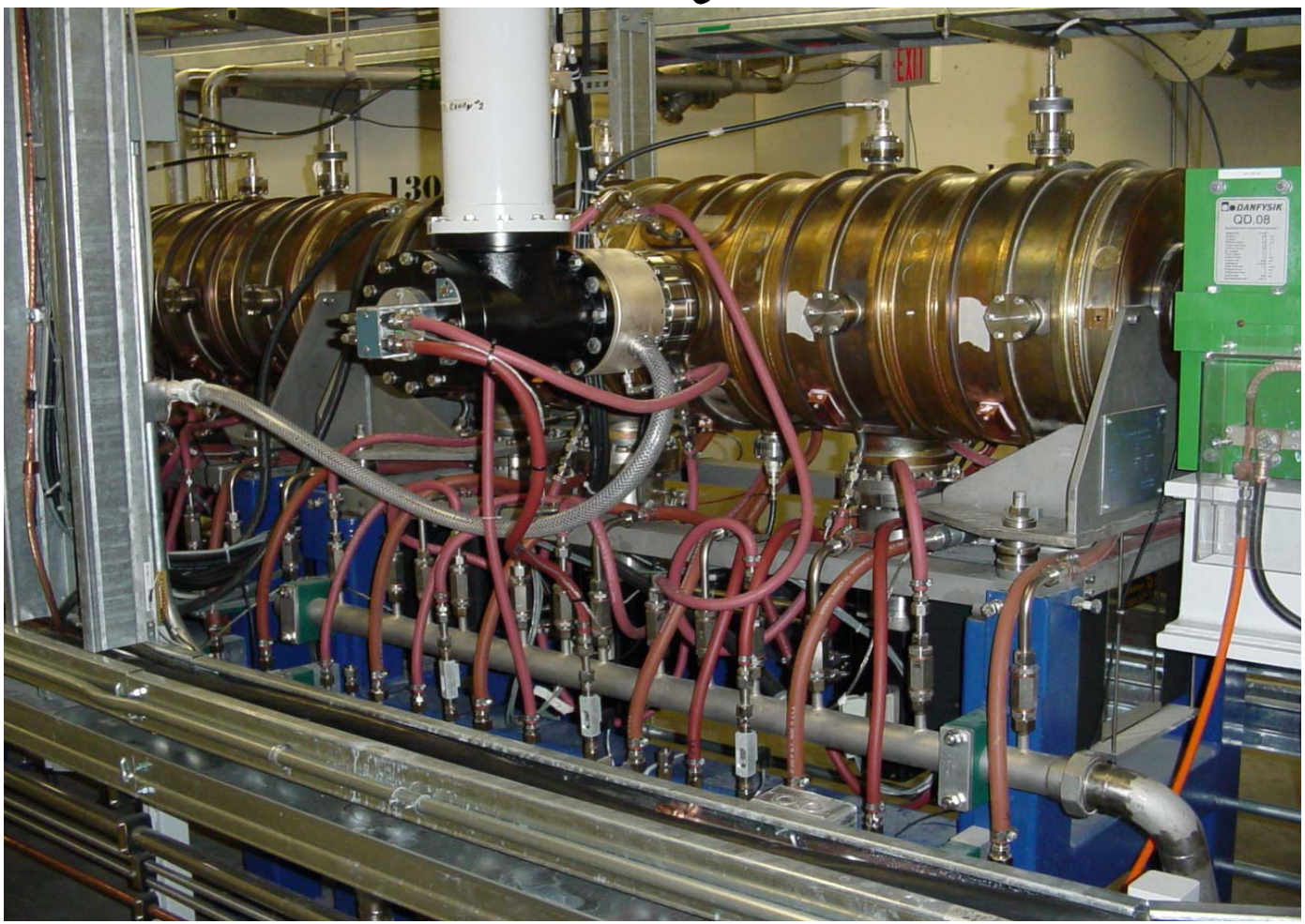


Courtesy of ACCEL

PETRA cavity

- 500MHz @ 30C
- Shunt impedance >14.5MOhm
- Qo 29,000
- RF Power min 65kW
- Amplitude field flatness +/- 5%
- RF coupler 65kW CW limit
- Beam tube flange DN63 CF
- 4 N type pickups
- Cooling water pressure 4-8 bar
- Cooling water flow 100 L/min
- Water tempreature stability +/- 1C

Petra cavity at CLS



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RF transmission

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RF power supplies

- 60kW RF supply
- 5 Hz rep rate
- RF drive modulation
- TV klystron
- IOT
- Transmitter based power supply

IOT

- 80kW
- 35kV 3Amp
- 160mm dia, 800mm long, 23Kg weight
- ~85% efficiency
- 300W drive
- 23dB gain

Klystron

- 70kW
- 28kV 5.4 Amp
- 2 Meters tall
- 50-65% efficiency
- 30W drive
- 40dB Gain

Tube choice

- Both the Klystron and IOT are readily available from manufactures at this power level
- Off the shelf transmitter systems based on TV using both types of tubes
- Unlikely that system spares/tubes of this size will become unavailable in the lifetime of Diamond

CLS power supply

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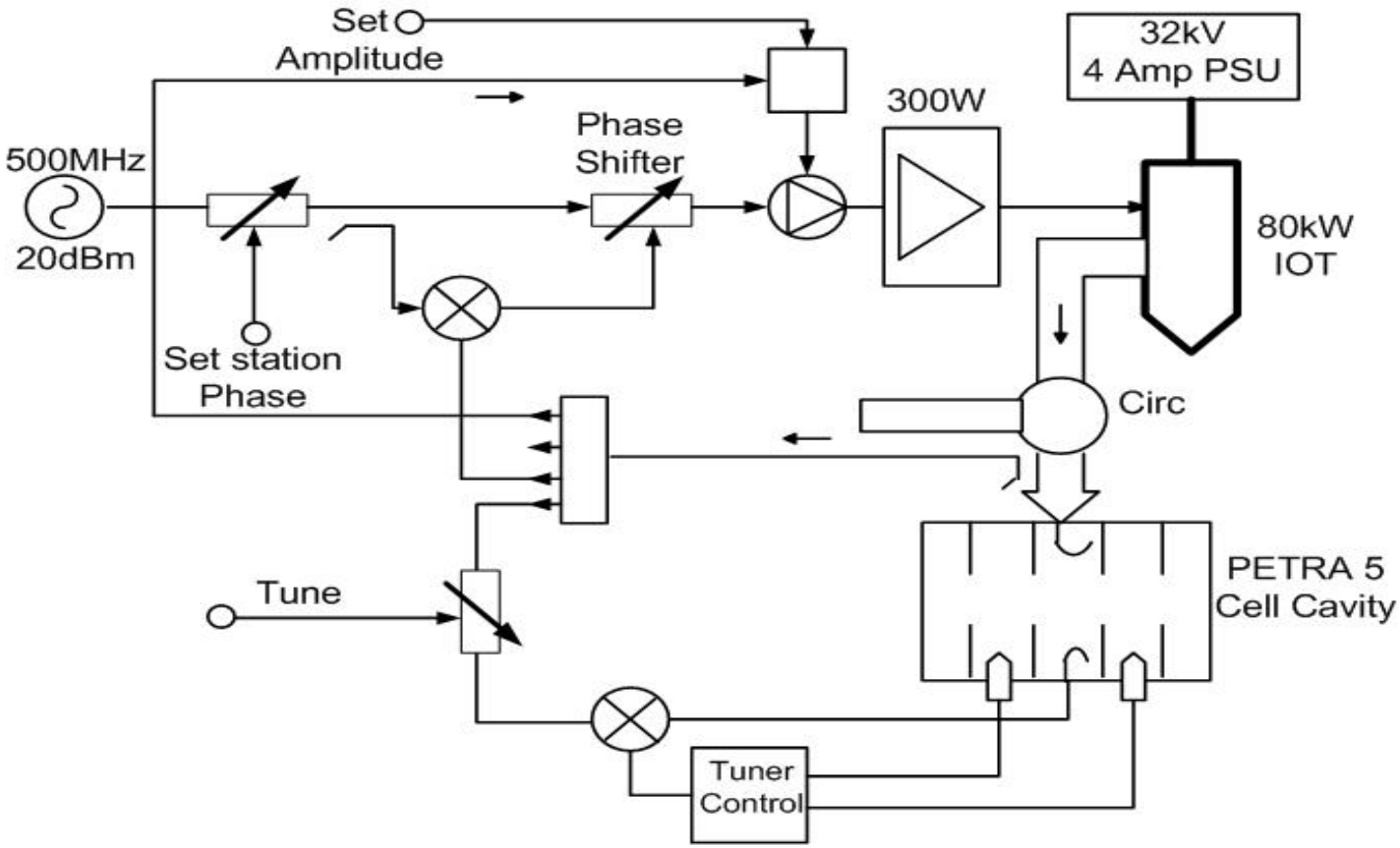
- Harris transmitter
- 70kW IOT

RF Path

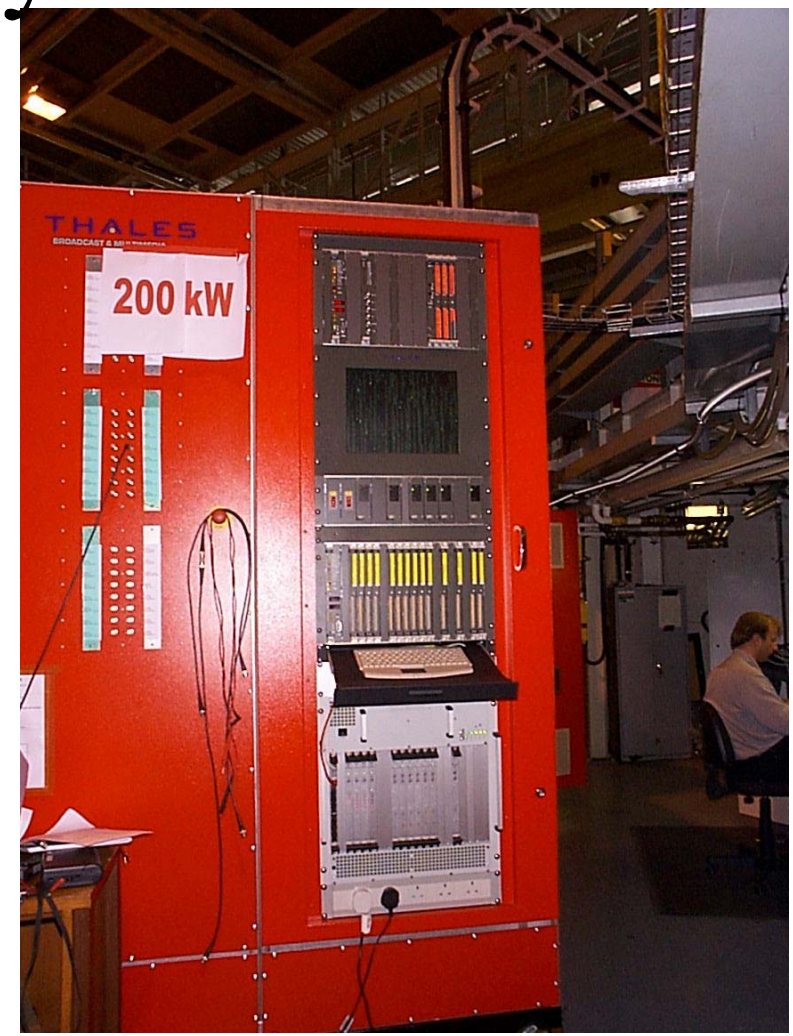

Set
Amplitude
32kV
4 Amp PSU
300W
Phase
Shifter
500MHz
20dBm
80kW
IOT
Set station
Phase
Circ
Tune
PETRA 5
Cell Cavity
Tuner
Control

Feedback systems

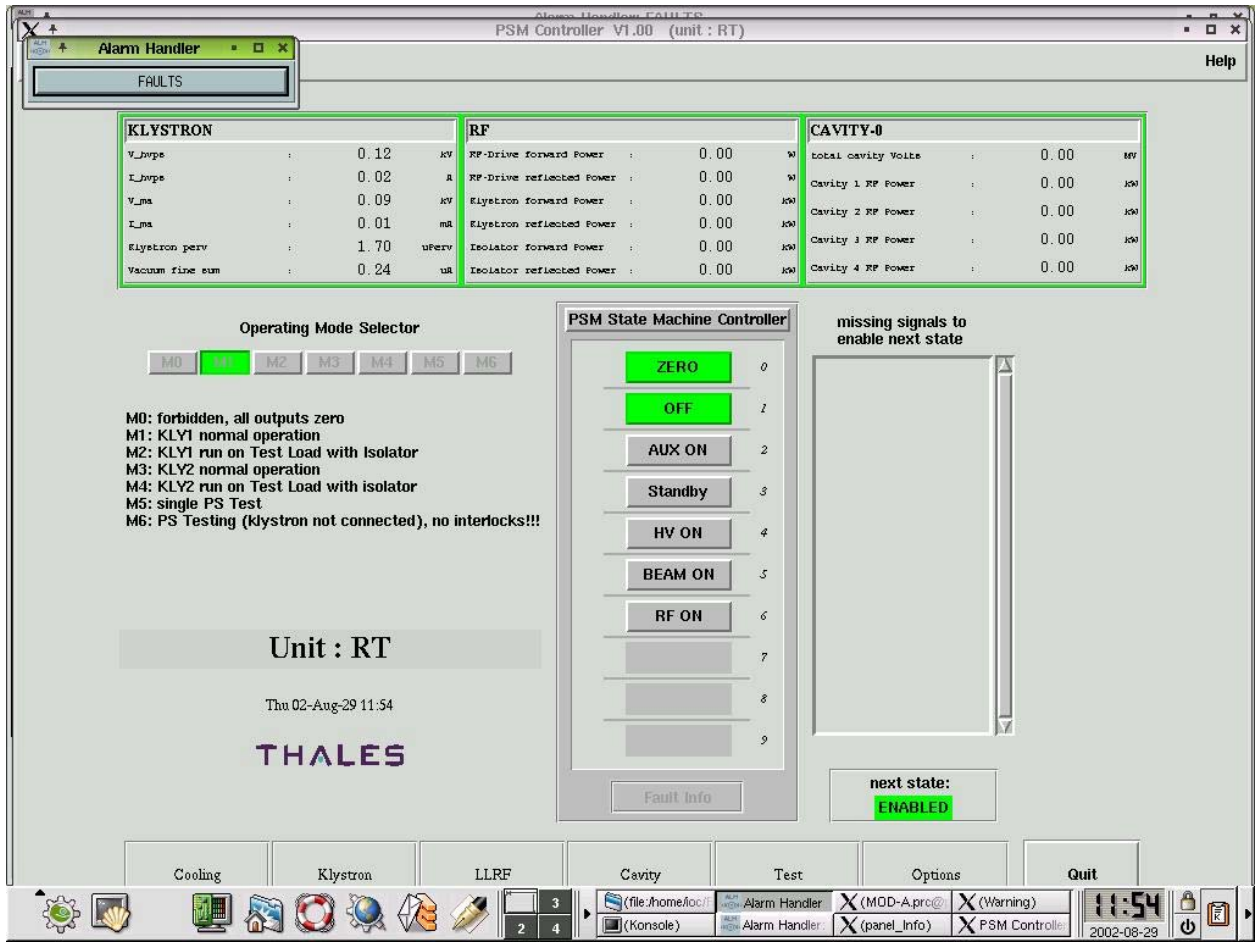
- Available with the cavity from ACCEL
- Comparison between centre cell and the incident RF
- Regulation is by two tuners on cells 2 & 4 driven by one phase feedback loop
- Also amplitude flatness is compared and adjusted automatically
- Amplitude loop driven from centre cell, adjusts RF drive to klystron

Control system

- Stand alone control system is very desirable
- EPICS based system will easily interface to the Diamond control system
- Good control system can double the cost of the power supply



User interface



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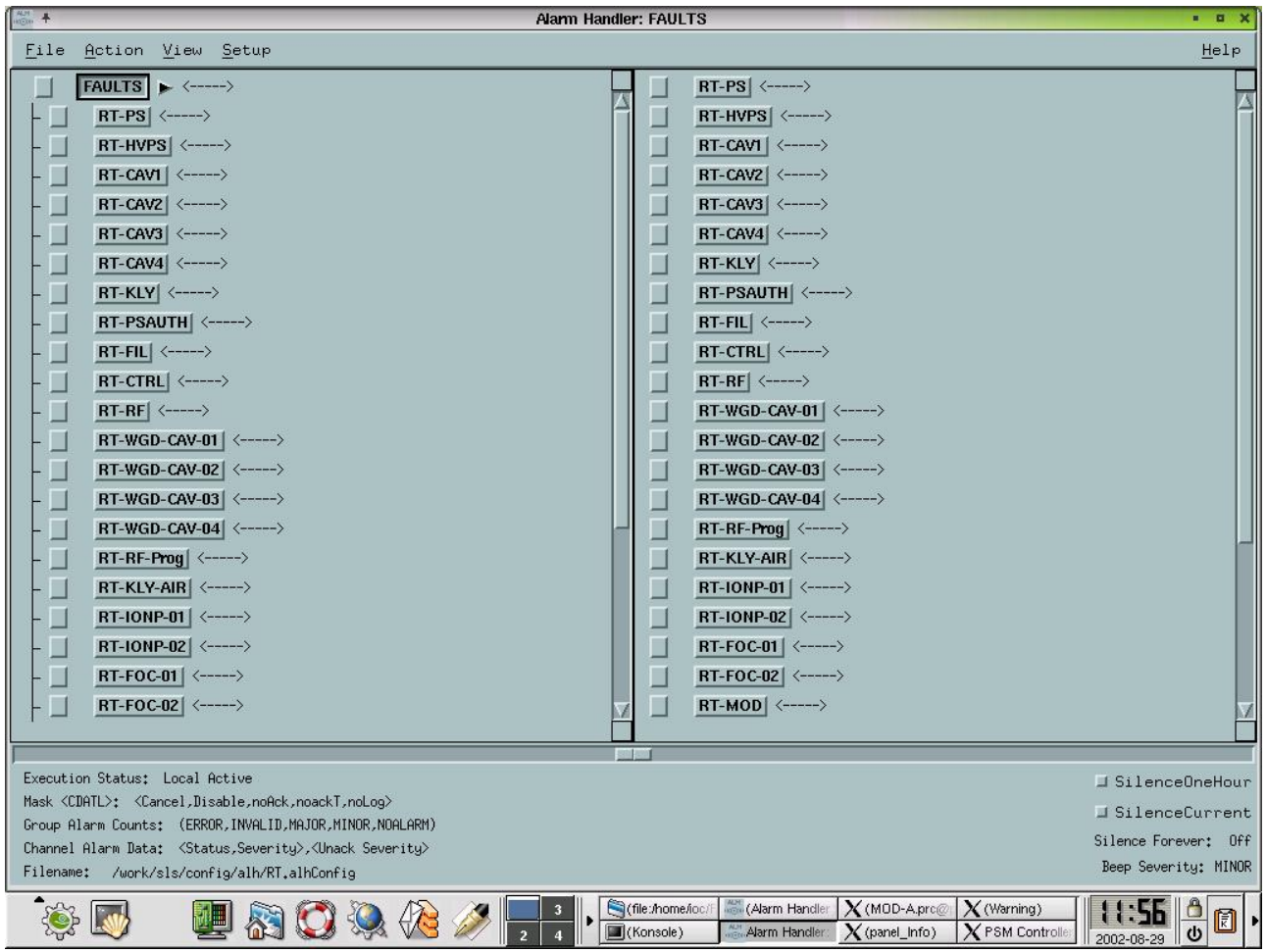
Alarm recording

- Alarm recording
- Event capture
- Logging



Top up operation

- Top up very likely for Diamond
- RF/Injection system must be able to run 24Hrs a day ~5000Hrs/year
- Specification will set ratings for components at 50% of the normal running condition
- Semiconductor junction temperatures must not exceed 100 C
- Top is not required from day 1

Timescales

- Specification for Booster RF system will be written by February 03
- Cavity, amplifier, control system, will be under one tender/ part tenders will be acceptable ?
- European tender, order during June 03>
- Install August 04 for one year
- Commissioning with beam September 05>